

Cisco – Configuring a Basic MPLS VPN

Table of Contents

<u>Configuring a Basic MPLS VPN</u>	1
<u>Introduction</u>	1
<u>Conventions</u>	2
<u>Hardware and Software Versions</u>	2
<u>Network Diagram</u>	2
<u>Configuration Procedures</u>	3
<u>Enabling ip cef</u>	3
<u>Configuring MP-BGP</u>	4
<u>Configurations</u>	4
<u>show Commands</u>	10
<u>Sample show Output</u>	10
<u>Routing Information</u>	10
<u>MPLS Labels</u>	11
<u>Tools Information</u>	11
<u>Related Information</u>	11

Configuring a Basic MPLS VPN

Introduction

Conventions

Hardware and Software Versions

Network Diagram

Configuration Procedures

Enabling **ip cef**

Configuring MP-BGP

Configurations

show Commands

Sample show Output

Routing Information

MPLS Labels

Tools Information

Related Information

Introduction

This document provides a sample configuration of a Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) over ATM when Border Gateway Protocol (BGP) or Routing Information Protocol (RIP) is present on the customer's site.

When used with MPLS, the VPN feature allows several sites to interconnect transparently through a service provider's network. One service provider network can support several different IP VPNs. Each of these appears to its users as a private network, separate from all other networks. Within a VPN, each site can send IP packets to any other site in the same VPN.

Each VPN is associated with one or more VPN routing or forwarding instances (VRFs). A VRF consists of an IP routing table, a derived Cisco express forwarding (CEF) table, and a set of interfaces that use this forwarding table.

The router maintains a separate routing and CEF table for each VRF. This prevents information being sent outside the VPN and allows the same subnet to be used in several VPNs without causing duplicate IP address problems.

The router using Multiprotocol BGP (MP-BGP) distributes the VPN routing information using the MP-BGP extended communities.

For more information regarding the propagation of updates through a VPN, see the following URLs:

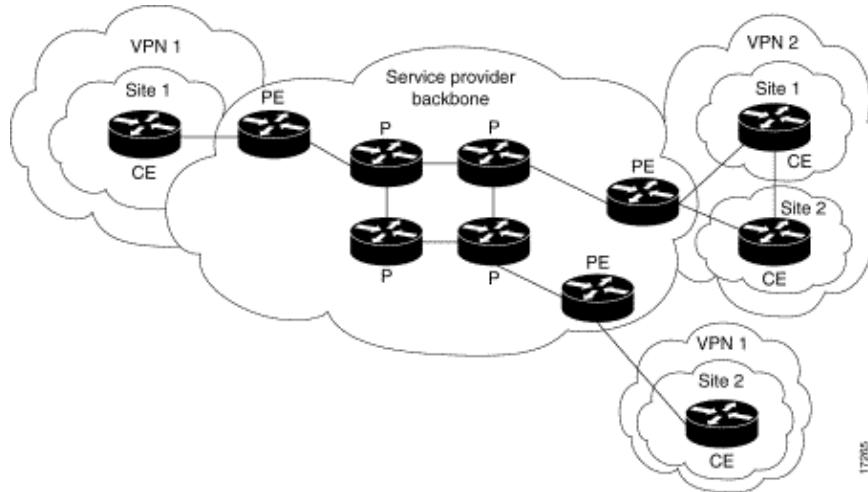
- VPN Route Target Communities
- BGP Distribution of VPN Routing Information
- MPLS Forwarding

Conventions

The letters below represent the different types of routers and switches used.

- P : Provider's core router
- PE : Provider's edge router
- CE : Customer's edge router
- C : Customer's router

This diagram shows a typical configuration illustrating the conventions outlined above.

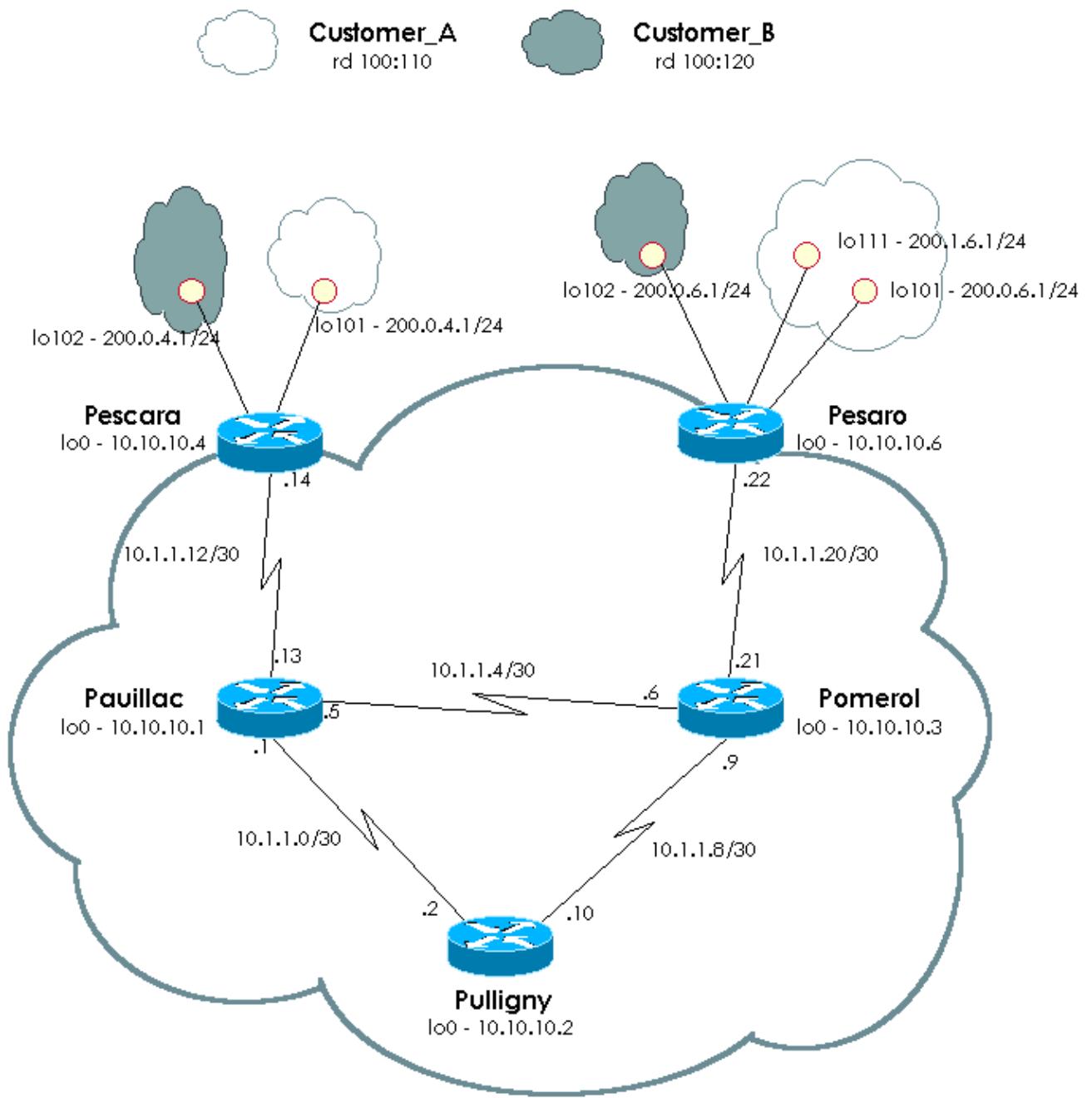


Hardware and Software Versions

This configuration was developed and tested using the software and hardware versions shown below.

- **P and PE routers:**
 - ◆ Software – Cisco IOS® Software Release 12.1(3)T. Release 12.0(5)T includes the MPLS VPN feature.
 - ◆ Hardware – Any Cisco router from the 3600 series or higher, such as the Cisco 3660 or 7206.
- **C and CE routers:** You can use any router that can exchange routing information with its PE router.

Network Diagram



Configuration Procedures

For more information, see MPLS Virtual Private Networks.

Enabling ip cef

Make sure that **ip cef** is enabled. For improved performance, use **ip cef distributed** (where available). Complete the following steps on the PEs after MPLS has been set up (configuring **tag-switching ip** on the interfaces).

1. Create one VRF for each VPN connected using the **ip vrf <VPN routing/forwarding instance name>** command. When doing this:

- ◆ Specify the correct route distinguisher used for that VPN. This is used to extend the IP address so that you can identify which VPN it belongs to.

rd <VPN route distinguisher>

- ◆ Set up the import and export properties for the MP–BGP extended communities. These are used for filtering the import and export process.

route-target [export/import/both] <target VPN extended community>

2. Configure the forwarding details for the respective interfaces using the following command.

ip vrf forwarding <VPN routing/forwarding instance name>

Remember to set up the IP address after doing this.

3. Depending on the PE–CE routing protocol you are using, you can configure static routes or routing protocols (RIP, Open Shortest Path First [OSPF], or BGP) between PE and CE. Detailed configurations are available on the MPLS over ATM Support Page.

Configuring MP–BGP

Configure MP–BGP between the PE routers. There are several ways to configure BGP, such as using the route reflector or confederation methods. The method used here—direct neighbor configuration—is the simplest and the least scalable.

1. Declare the different neighbors.

2. Enter the **address-family ipv4 vrf <VPN routing/forwarding instance name>** command for each VPN present at this PE router. Carry out one or more of the following steps, as necessary:

- ◆ Redistribute the static routing, RIP, or OSPF information.
- ◆ Redistribute connected routing information.
- ◆ Activate BGP neighboring with the CE routers.

3. Enter the **address-family vpnv4** mode, and complete the following steps:

- ◆ Activate the neighbors.
- ◆ Specify that extended community must be used. This is mandatory.

Configurations

Configuration commands specific to Customer_A are in red, to Customer_B in blue, and to both in fuchsia.

Pescara
<pre>Current configuration: ! version 12.0</pre>

```

!
hostname Pescara
!
ip cef
!
ip vrf Customer_A
  rd 100:110
  route-target export 100:1000
  route-target import 100:1000
!
ip vrf Customer_B
  rd 100:120
  route-target export 100:2000
  route-target import 100:2000
!
clns routing
mpls traffic-eng tunnels
!
interface Loopback0
  ip address 10.10.10.4 255.255.255.255
  ip router isis
  clns router isis
!
interface Loopback101
  ip vrf forwarding Customer_A
  ip address 200.0.4.1 255.255.255.0
  no ip directed-broadcast
!
interface Loopback102
  ip vrf forwarding Customer_B
  ip address 200.0.4.1 255.255.255.0
  no ip directed-broadcast
!
interface Serial0/1
  no ip address
  no ip directed-broadcast
  encapsulation frame-relay
  no fair-queue
!
interface Serial0/1.1 point-to-point
  description link to Pauillac
  bandwidth 512
  ip address 10.1.1.14 255.255.255.252
  no ip directed-broadcast
  ip router isis
  tag-switching ip
  clns router isis
  frame-relay interface-dlci 401
!
router isis
  net 49.0001.0000.0000.0004.00
  is-type level-1
!
router bgp 100
  bgp log-neighbor-changes
  neighbor 10.10.10.6 remote-as 100
  neighbor 10.10.10.6 update-source Loopback0
  !
  address-family vpnv4
    neighbor 10.10.10.6 activate
    neighbor 10.10.10.6 send-community both
  exit-address-family
  !
  address-family ipv4 vrf Customer_B

```

```

redistribute connected
no auto-summary
no synchronization
exit-address-family
!
address-family ipv4 vrf Customer_A
redistribute connected
no auto-summary
no synchronization
exit-address-family
!
ip classless
!
end

```

Pesaro

```

Current configuration:
!
version 12.1
!
hostname Pesaro
!
ip vrf Customer_A
rd 100:110
route-target export 100:1000
route-target import 100:1000
!
ip vrf Customer_B
rd 100:120
route-target export 100:2000
route-target import 100:2000
!
ip cef
clns routing
!
!
interface Loopback0
ip address 10.10.10.6 255.255.255.255
ip router isis
clns router isis
!
interface Loopback101
ip vrf forwarding Customer_A
ip address 200.0.6.1 255.255.255.0
!
interface Loopback102
ip vrf forwarding Customer_B
ip address 200.0.6.1 255.255.255.0
!
interface Loopback111
ip vrf forwarding Customer_A
ip address 200.1.6.1 255.255.255.0
!
interface Serial0/0
no ip address
encapsulation frame-relay
no ip mroute-cache
random-detect
!
interface Serial0/0.1 point-to-point
description link to Pomerol
bandwidth 512
ip address 10.1.1.22 255.255.255.252

```

```

ip router isis
tag-switching ip
clns router isis
frame-relay interface-dlci 603
!
router isis
net 49.0001.0000.0000.0006.00
is-type level-1
!
router bgp 100
neighbor 10.10.10.4 remote-as 100
neighbor 10.10.10.4 update-source Loopback0
!
address-family ipv4 vrf Customer_B
redistribute connected
no auto-summary
no synchronization
exit-address-family
!
address-family ipv4 vrf Customer_A
redistribute connected
no auto-summary
no synchronization
exit-address-family
!
address-family vpnv4
neighbor 10.10.10.4 activate
neighbor 10.10.10.4 send-community both
exit-address-family
!
ip classless
!
end

```

Pomerol

```

Current configuration:
!
version 12.0
!
hostname Pomerol
!
ip cef
clns routing
!
interface Loopback0
ip address 10.10.10.3 255.255.255.255
ip router isis
clns router isis
!
interface Serial0/1
no ip address
no ip directed-broadcast
encapsulation frame-relay
random-detect
!
interface Serial0/1.1 point-to-point
description link to Pauillac
ip address 10.1.1.6 255.255.255.252
no ip directed-broadcast
ip router isis
tag-switching mtu 1520
tag-switching ip
clns router isis

```

```

frame-relay interface-dlci 301
!
interface Serial0/1.2 point-to-point
description link to Pulligny
ip address 10.1.1.9 255.255.255.252
no ip directed-broadcast
ip router isis
tag-switching ip
clns router isis
frame-relay interface-dlci 302
!
interface Serial0/1.3 point-to-point
description link to Pesaro
ip address 10.1.1.21 255.255.255.252
no ip directed-broadcast
ip router isis
tag-switching ip
clns router isis
frame-relay interface-dlci 306
!
router isis
net 49.0001.0000.0000.0003.00
is-type level-1
!
ip classless
!
end

```

Pulligny

```

Current configuration:
!
version 12.1
!
hostname Pulligny
!
!
ip cef
clns routing
cns event-service server
!
!
interface Loopback0
ip address 10.10.10.2 255.255.255.255
!
interface Serial0/1
no ip address
encapsulation frame-relay
random-detect
!
interface Serial0/1.1 point-to-point
description link to Pauillac
ip address 10.1.1.2 255.255.255.252
ip router isis
tag-switching ip
clns router isis
frame-relay interface-dlci 201
!
interface Serial0/1.2 point-to-point
description link to Pomerol
ip address 10.1.1.10 255.255.255.252
ip router isis
tag-switching ip
clns router isis

```

```
frame-relay interface-dlci 203
!
router isis
  passive-interface Loopback0
  net 49.0001.0000.0000.0002.00
  is-type level-1
!
ip classless
!
end
```

Pauillac

```
!
version 12.1
!
hostname pauillac
!
ip cef
clns routing
cns event-service server
!
interface Loopback0
  ip address 10.10.10.1 255.255.255.255
  ip router isis
  clns router isis
!
interface Serial0/0
  no ip address
  encapsulation frame-relay
  no ip mroute-cache
  tag-switching ip
  no fair-queue
!
interface Serial0/0.1 point-to-point
  description link to Pomerol
  bandwidth 512
  ip address 10.1.1.1 255.255.255.252
  ip router isis
  tag-switching ip
  clns router isis
  frame-relay interface-dlci 102
!
interface Serial0/0.2 point-to-point
  description link to Pulligny ip address 10.1.1.5 255.255.255.252
  ip access-group 150 out
  ip router isis
  tag-switching ip
  clns router isis
  frame-relay interface-dlci 103
!
interface Serial0/0.3 point-to-point
  description link to Pescara
  bandwidth 512
  ip address 10.1.1.13 255.255.255.252
  ip router isis
  tag-switching ip
  clns router isis
  frame-relay interface-dlci 104
!
router isis
  net 49.0001.0000.0000.0001.00
  is-type level-1
!
```

```

ip classless
!
end

```

show Commands

The following commands are illustrated below:

- **show ip vrf**
- **show ip vrf interfaces**
- **show ip route vrf Customer_A**
- **traceroute vrf Customer_A 200.0.6.1**

Other interesting commands (not illustrated here) include:

- **show ip bgp vpnv4 tag**
- **show ip cef vrf Customer_A 200.0.6.1 detail**

More commands are detailed in the MPLS VPN Solution Troubleshooting Guide.

Sample show Output

You can use the following command to verify that the correct VRF exists:

```
Pescara#show ip vrf
Name                               Default RD      Interfaces
Customer_A                         100:110       Loopback101
Customer_B                         100:120       Loopback102
```

To check the activated interfaces, use the following command.

```
Pesaro#show ip vrf interfaces
Interface          IP-Address      VRF                                Protocol
Loopback101        200.0.6.1       Customer_A                         up
Loopback111        200.1.6.1       Customer_A                         up
Loopback102        200.0.6.1       Customer_B                         up
```

Routing Information

You can check routing information on the PE routers using the **show ip route** command followed by **vrf** and the VRF name.

```
Pescara#show ip route vrf Customer_A
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
```

Gateway of last resort is not set

```
C    200.0.4.0/24 is directly connected, Loopback101
B    200.0.6.0/24 [200/0] via 10.10.10.6, 05:10:11
B    200.1.6.0/24 [200/0] via 10.10.10.6, 04:48:11
```

MPLS Labels

By running a traceroute between two sites of Customer_A, it is possible to see the label stack used by the MPLS network (if it is configured to do so by **mpls ip ttl ...**).

```
Pescara#traceroute vrf Customer_A 200.0.6.1
```

```
Type escape sequence to abort.  
Tracing the route to 200.0.6.1
```

```
1 10.1.1.13 [MPLS: Labels 20/26 Exp 0] 400 msec 276 msec 264 msec  
2 10.1.1.6 [MPLS: Labels 18/26 Exp 0] 224 msec 460 msec 344 msec  
3 200.0.6.1 108 msec * 100 msec
```

Note: `Exp 0` is an experimental field used for Quality of Service.

Tools Information

For additional resources, refer to Cisco TAC Tools for Routing Protocol Technologies.

Related Information

- [MPLS Support Page](#)
 - [IP Routing Top Issues](#)
 - [More IP Routing Technical Tips](#)
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